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VECTORIAL CEREBRAL HEMISPHERICITY AS DIFFERENTIAL SOURCES FOR THE SENSED PRESENCE, MYSTICAL EXPERIENCES AND RELIGIOUS CONVERSIONS[1]

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Summary.—Multiple variants of the sensed presence often precede mystical and religious experiences that are frequently followed by sudden, permanent changes in self-concept. The model of vectorial hemisphericity assumes that the relative metabolic activity of synaptic patterns between the cerebral hemispheres at the time of transient interhemispheric intercalation determines the affect, content, and type of experience. Depending upon the relative activity of the two hemispheres, intrusions of the right hemispheric equivalent of the left hemispheric (and linguistic) sense of self generate experiential phenomena that include "evil entities," gods, out-of-body experiences, and alterations in space-time. Conditions that facilitate interhemispheric intercalation and the generation of these experiences are discussed.

Contemporary neuroscience suggests that *all* human experiences are a function of microstructural (synaptic, receptor aggregate, neurotransmitter, and kinetic) determinants. Several researchers (Edelman, 1989; Jaynes, 1976; Silberman & Weingartner, 1986) have hypothesized that the sense of human self is an aggregate property that emerges from the language processes. Given the linguistic basis of left hemisphere specialization (Corina, Vaid, & Bellugi, 1992), this sense of self (Epstein, 1981) should emerge following some critical mass of neuronal organization and should involve (primarily) left hemispheric processing. Persinger and Makarec (1992) have hypothesized that a homologue of the left hemispheric operation for the generation of self must occur within a comparable right hemispheric process.

Given the intrinsic differences in microstructural organization, metabolic activity, and temporal (phase) displacement (Livanov, Gavrilova, & Aslanov, 1973) between the hemispheres, intercalation between the two analogous patterns would be infrequent. The concept is a variant of the assumption that neuroelectrical patterns (and their cognitive correlates) remain compartmentalized and "unconscious" unless they can be represented within the appropriate cortices (Sommerhoff, 1974) through re-entrant systems (Edelman, 1989). The model is compatible with the class of (negative) interaction models for interhemispheric activity and assumes that (under normal conditions) simultaneous interaction (and competition) between hemispheres is prevented by inhibitory transcallosal collaterals.

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In the tradition of Jaynes (1976) we have predicted that *any* stimulus operation, microstructural reorganization (including reactive synaptogenesis following local injury, alterations in numbers of ACTH or corticosteroid receptors within ensembles of inhibitory neurons due to psychological distress and even normal ontogenetic change), or intrinsic electrical pattern that facilitates interhemispheric intercalation or the transient "breakdown" of these interhemispheric boundaries would allow the brief intrusions (e.g., temporal lobe transients; Persinger, 1983b) of the representation (and hence awareness) of the right hemispheric homologue of self into the left hemispheric processing.

Intercalation is defined as the inclusion of neuronal sequences (from the other hemisphere) within a time frame that would allow both recognition (compatible integration) and discrimination (contrast patterns, i.e., those that remain when the phase-coupled signals from both hemispheres are cancelled) simultaneously. Considering the relative infrequency of these experiences in the normal waking brain (which emphasizes traditional left hemispheric processes; Gordon, 1986), the representational sequence must be an event of low probability.

The right hemispheric intrusions are experienced as sensed presences that are described as "impressions," "entities," "ghosts," "old hags," Cosmic Consciousness and Spiritual Beings; the experiences, whose characteristics should reflect the major function of the right hemisphere and the themes of the specific cerebral regions that generate the sequences, are maximally affective and minimally linguistic and are judged more frequently as unpleasant (fearful, avoidance) than as pleasant (security, approach). Similar intrusions may be associated with "sudden knowledge" and changes in the self-concept that define religious conversions (Dewhurst & Beard, 1970; Persinger, 1987).

Because of the powerful effects of these experiences upon religious beliefs and their influence upon the historical human proclivity (1) to engage in group delusional episodes such as the satanic conspiracy panics or witch hunts (Hicks, 1991) and (2) to kill other human beings on the basis of differences in beliefs, these phenomena deserve special consideration. If clinical strategies could access these same fundamental neurocognitive processes, then both the efficiency and effect of counselling tactics could be increased remarkably. The following model of vectorial hemisphericity was developed to facilitate this understanding; it could also be considered as a theory of neurophenomenology.

The model allows a continuum of experiential phenomena that are encouraged by any process if it facilitates transient enhancement of interhemispheric coherence (intercalation) between (primarily) the temporoparietal cortices and the adjacent ventral limbic lobes. The cortices would mediate cognitive (perceptual; detailed) phenomenology while the subcortical limbic or

temporopolar (paralimbic) regions would generate strong affective experiences; the most common temporal sequence of activation should proceed along limbic and then cortical routes (Persinger, 1993). For simplicity, the concept of vectorial hemisphericity can be represented as three metabolic states (below normal, normal, and above normal) for the left and right hemispheres separately. Transient intercalation of processes can occur whenever the simultaneous (synaptic) metabolic activity of both hemispheres is not normal.

As suggested by PET (positron emission tomography) studies (Chugani & Phelps, 1986; Pawlik & Heiss, 1989), the themes of experiential phenomena are correlated with the functions of those portions of the brain that are most metabolically active at the time of the experience (Pawlik & Heiss, 1989). These neurophenomenological correlates are evident even though PET reflects the averages of metabolic activity within large aggregates of neurons and consequently is only a crude inference of intersynaptic or internodal patterns. Within a neurocognitive perspective the contents of subjective experiences should reflect the temporal sequence of the hemisphere and the intrahemispheric regions that display the greatest metabolic activity. A relative increase in activity could result from either direct stimulation or disinhibition (release activity) due to damage or decreased function within inhibitory regions (Persinger, 1989).

Whereas immediate experiences should reflect temporoparietal activity, beliefs would involve the perceptual organization of experiences and expectancies [primary features of the self, Combs, 1981] and would require additional input from prefrontal lobe processes (Moscovitch, 1989). Anomalies in temporal-orbitofrontal-prefrontal lobe function, which could alter inferential thinking, could encourage confabulation (Moscovitch, 1989) and delusions. Anomalies within the right temporal lobe would encourage a gradual, cumulative modification (successive confabulation) of episodic (autobiographical) memory, even several years after its acquisition (Persinger, 1992b).

Clear examples of the principle that "regions of the greatest metabolic activity determine the fabric of phenomenology" are displayed by complex partial epileptic patients (Gloor, Olivier, Quesney, Andermann, & Horowitz, 1982). Focal elevations of right occipitotemporal activity occur during visuospatial hallucinations and local activation of the left temporal cortices is evident during auditory hallucinations. These brief periods of exaggerated metabolic activity and intense subjective phenomenology are followed by prolonged interictal temporal lobe hypometabolism (Henry, Mazziotta, Engel, Christenson, Zhang, Phelps, & Kuhl, 1990).

Persinger and Makarec (1987, 1992, 1993) and Richard J. Roberts and his colleagues (1990) have shown that the experiential reports of complex partial epileptics are simply more intense manifestations of the neurocogni-

tive processes [as are probably all extreme clinical syndromes; Persinger, 1991] that occur less frequently in the normal population. If such a continuum of temporal lobe lability exists, then people who report *brief* periods of intense phenomenology, such as the experience of a presence, should also be prone to baseline or "interictal" hypometabolism and less effective (but not necessarily pathological) function. The moderate, positive correlation between numbers of left-ear suppressions during a dichotic listening task and experiences of the sensed presence in normal women (Lavallée & Persinger, 1992) is compatible with this principle.

There are general pathways by which intrusive experiences could be mediated. On the bases of traditional neuroanatomy, one would expect the affective (primarily fear) components to be mediated from the deep mesiobasal (amygdaloid-hippocampal) regions through the anterior commissure and indirectly from the central amygdaloid nuclei through brain stem pathways (Lieb, Hoque, Skomer, & Song, 1987). Spread from (for example) the right amygdala by the latter route to the contralateral (left) amygdala and generalization to the cortices could require as long as 20 seconds.

The subsequent bilateral stimulation of mesiobasal and thalamic regions would encourage interhemispheric intercalation. Because both hemispheric sequences would be generated by the same amygdaloid discharge, the person could feel as if the experience has occurred before (déjà-vu), particularly if the time between the two sequences was between the temporal resolution capacity (two stimuli are considered as one versus two events) of the perceptual system and interhemispheric processing (about 30 msec.). If the time between the two sequences was within the framework of short-term memory, i.e., <20 sec., then (with repeated occurrences) the person could learn to anticipate the imminent occurrence of the "intrusion."

The induction of fear-like experiences during application of weak magnetic fields (patterned after endogenous amygdaloid burst firing sequences) to the right temporal lobe (Richards, Koren, & Persinger, 1992) is commensurate with this model. These experiences were not reported when the same pattern was applied to the left temporal lobe. Direct stimulation of the midline thalamic nuclei by amygdaloid input through the inferior thalamic peduncle could simultaneously but differentially generate signals within both hemispheres, a process that would promote intercalation. One would expect, as has been reported (Richards, *et al.*, 1992), that a sensed presence with fear would occur.

On the other hand, experiences of variants of the body image such as entities (Evans, 1984) and intrusive voices would involve mediation of temporoparietal information through the corpus callosum. The correlations between dichotic listening errors and spiritualistic experiences (souls, visitation by guardian angels) and beliefs (Lavallée & Persinger, 1992) and the associa-

tion between the amount of right (relative to left) temporal-lobe theta activity and the experiences of fear and a sense of presence during partial sensory deprivation (Munro & Persinger, 1992) support this supposition.

The first and most common transient within the framework of vectorial hemisphericity is the above-normal activity in the right hemisphere compared to normal left hemispheric function (Vingiano, 1989). The correlative phenomenology would involve a sensed presence. Because the right hemisphere subserves vigilance and its more extreme variant (anxiety, fear, or panic), these experiences should be primarily negative and would be enhanced within partial sensorideprived environments (Suedfeld & Mocellin, 1987). Semantic designators would involve the domain of "evil" or "bad." Examples would include the "Old Hag," entities, demons, some succubi/incubi and more recently extraterrestrial "examinations" (Evans, 1984). They have been considered the "mental diplopic" homologue of the left hemispheric sense of self.

Because intrinsic visuospatial and vigilance-oriented properties of the right hemisphere cannot be totally translated into left hemispheric labels and images, these experiences would reflect the resultant distortions of visuospatial patterns, e.g., odd-shaped humanoids or poorly organized body forms. Stimulation of cells within the ventral (infero) temporal cortex and adjacent parahippocampal (limbic) lobe that code for faces (Kendrick & Baldwin, 1987; Young & Yamane, 1992) or hands (Gross, Rocha-Miranda, & Bender, 1972) would imbue these experiences with predictable distortions. [For example, one of our patients, who displayed focal right temporal (scalp electrode) spikes during personal distress would suddenly experience fear (apprehension) and then a sensed presence; within 10 sec. a "gnarled hand," inferred as male, would "protrude" into her left visual field.]

In the normal waking person, occasional intrusions of ego-alien experiences from right-hemispheric processes should occur most frequently during the early morning hours, personal distress, anxiety, or depression. During normal dreaming (Gordon, Frooman, & Lavie, 1982), when right laterality as defined by Gordon (1986) predominates, experiences of ego-alien intrusions, such as "the stranger" or "the other," should be and are not only frequent but *normal* (Hobson, 1988). As expected, the affective theme of dreams is primarily negative (apprehensive) and is associated with enhanced vigilance.

Cyclothymic or hypomanic individuals, who predominate the fields of creative writing, music and the arts, would be prone to the sensed presence, particularly during periods (such as midnight to 0400 hr.) when right hemispheric intrusions are encouraged. The intrusive experiences of this population would involve a second combination: transient above-normal left hemispheric activity and transient above-normal right hemispheric activity. The elevation of the former would be associated with the intense linguistic pro-

cessing that is associated with creative ideation. Because elevated left hemispheric activity subserves positive affect (Goldberg & Costa, 1981; Silberman & Weingartner, 1986), the intrusions would be more pleasant, e.g., inspirational.

[Although creativity would be associated with anomalous increases in cerebral activity that allow interaction between neuroelectrical patterns that typically would not be accessed, the hypermetabolism is self-limiting. If this boundary of activity did not occur, then excitotoxic damage could ensue. The subsequent compensatory decrease in linguistic processing following the creative episode and correlative depression would be reflected in the cyclothymic individual as a "nonproductive" period and in more severely affective cases as clinical depression.]

This form of sensed presence, which would also constitute a significant portion of mystical experiences, is likely to have been the phenomenological basis for the frequent attribution of creativity to extrapersonal sources such as spirits, Divine entities or Muses (Persinger & Makarec, 1992). Because these periods are associated with enhanced left-hemispheric activity and enhanced semantic meaning (e.g., reading prose and poetry and experiencing profound personal understanding of the universe or the self), the right hemispheric intrusions would be infused with positive affect (Persinger, 1992a). Factor analyses of phenomenological clusters (Persinger & Makarec, 1992) support a connection between periods of poetry and prose writing and recitation of poetry or religious prose, such as scriptures, and the sensed presence in normal adults. However unlike limbic epileptic patients (without cognitive impairment) who display primarily right temporal-lobe foci (a constant source for generation of patterns that could intrude the left hemisphere) and hypergraphia (Hoeppner, Garron, Wilson, & Koch-Weser, 1987; Waxman & Geschwind, 1974), episodes of "profound writing and understanding" would be brief.

The capacity for hemispheric interfacing is a function of the similarity of the cytoarchitecture between brain regions and the precipitating stimuli that contributes to the coherence; the details of the experience would reflect the characteristics (functions) of the source region. For example, brief coherence from sudden elevations in right hemispheric activity should be associated with diplopic allocentric references (other dimensions; alterations in space-time) while coherence due to elevations in left hemispheric activity would be associated with diplopic egocentric references. If the cognitive processes associated with the sense of self intrude into the right hemisphere and then back into the left hemisphere (via the corpus callosum), then diplopic egocentric references such as an out-of-body experience, astral travelling or "detachment of the self from the body" could be experienced. The reported increases in out-of-body experiences or astral travelling during si-

multaneous activity of both hemispheres induced by synchronized dichotic tonal patterns (Persinger, 1992a) is compatible with this prediction.

The cognitive operation that addresses the existence of the self in context of space and time as well as its ultimate extinction (death) is primarily a linguistic and highly symbolic left-hemispheric phenomenon. It is a normal process that minimizes dissolution of the self-concept and the subsequent incapacitating anxiety from persistent right hemispheric intrusions (Persinger, 1987). This existential anxiety has been described as a symptom of the semantic conditioned suppression for the implicit linguistic operation "I will die." All world religions have generated variations of one of three general solutions to this problem (Persinger, 1985).

Survival of the sense of self is made contingent upon syntactic association with the language's default concept for all of space and all of time, e.g., deities, gods. This intricate confound between sense of self, linguistic processing, and religious beliefs may explain the persistent conviction that direct "interactions" with gods (e.g., Allah, Jehovah) or entities requires "only" thought or specific language patterns, such as rituals or prayers. An assumption that phenomenology is a neuroelectrical pattern would predict that any thought sequence which subjugates ("we're not worthy") or decreases self-esteem ("I'm only your humble servant") would encourage a right hemispheric intrusion.

If left hemisphericity mediates this triad, then one would expect elevated self-esteem, interests in language and logic, and endorsement of traditional religious experiences and beliefs to be associated with individuals who exhibit more left hemispheric function. As predicted, only Tobacyk's (Persinger & Richards, 1991) scale of traditional religious beliefs (but not exotic, paranormal beliefs) has been significantly and positively associated with self-esteem (Lavallée & Persinger, 1992). Factor analysis also indicated that exotic beliefs (e.g., previous lives, extraterrestrial aliens are responsible for UFOs) are more associated with Vingiano's right hemisphericity while traditional religious beliefs (e.g., existence of God cannot be explained by Science, second coming of Christ) are associated with left hemisphericity.

The concurrence between egocentricism (experiences by the self are real despite counter-evidence or empirical data), elevated self-esteem, serial (logical) thinking, exaggerated importance of the self and one's beliefs, authoritarianism, and religious beliefs is a common demographic observation in the normal population (Altmeyer, 1988). If egocentrism (rather than allocentricism) is a left hemispheric process, then brains that are relatively more left lateralized for linguistic processing, such as the normal right-handed male, should be prone to these behaviors. Even in an allegedly rational population (university students), right-handed men are twice as likely to endorse items such as "If God told me to kill, I would do it in his name" and to believe

they enjoy a special capacity for survival (Persinger, 1993). Right hemispheric intrusions for these individuals, given their egocentrism, would be experienced as exceptionally real.

Although patients who display complex partial epilepsy (with or without secondary generalized convulsions) should be and are (Dewhurst & Beard, 1970) particularly prone to mystical experiences and sudden religious conversions (which, defined behaviorally, are abrupt, marked re-definitions of the self-concept and changes in self-esteem), intense religiosity should only emerge when chronic left temporal-lobe foci develop that display interictal spike patterns (Bear & Fedio, 1977). As indicated by Trimble (1982), such chronicity is required for the experiences to be integrated, through intermittent accumulation, into the person's self-concept.

For these changes to occur synaptic reorganization would be required. Neuroplasticity in the adult epileptic brain, as defined by axonal sprouting of mossy fibres within the supragranular zone of the inner molecular region of the dentate gyrus (Sutula, Cascino, Cavazos, Parada, & Ramirez, 1989), would alter the commissural pathway. This could explain the anomalous enhanced recruitment of the amygdala by hippocampal stimulation (Buser & Bancaud, 1983) that is observed in limbic epilepsy. Because of the significant prefrontal input into the hippocampal-amygdaloid region, disruptions in cognitive expectancy such as discrepancies between personal goals and actual achievements (i.e., life crisis), stimulus overload, sudden alterations in bonding (death of parent) or extreme social change, could activate a religious conversion.

In the nonepileptic hippocampus, any process that facilitates dropout of inhibitory interneurons (Sloviter, 1987) and encourages abnormal functional activity (Sutula, *et al.*, 1989), such as persistent limbic stimulation of hypothalamic corticotrophin (CRF) and the correlative elevation of ACTH or corticosteroid levels, could also encourage comparable alterations in neural organization (Sapolsky, 1987). Intrahippocampal changes that are similar to those found in complex partial epileptic patients (de Lanerolle, Kim, Robbins, & Spencer, 1989) may be characteristic of the normal geriatric brain. These alterations could explain the normal increased incidence of electroencephalographic spikes over the temporal lobes of older people (Reitan & Wolfson, 1985) as well as their proclivity to experience religious conversions and to embrace these beliefs.

The religiosity would emerge because of the more periodic and frequent enhancement in intersynaptic metabolism within the left temporal lobe (secondary to the synaptic reorganization) and the more numerous episodes of intertemporal lobe coherence. Both processes would encourage linguistic rumination of the frequent right hemispheric intrusions. Integration of these intrusions into the continually modified self-concept would confuse the boundaries between the self and the nonself.

The primary difference between the dissociative, creative poet, who transiently experiences these intrusions, and the patient with a chronic left temporal lobe focus is best described by Laing (1969). Whereas the poet can conceptualize about the universe or God and remain intact, the schizophrenic confuses and ultimately loses the boundaries. Consequently, philosophical obsessions with nascent (origin) themes, confusions between the self and the universe (or God), over-attribution of the significance of the self (personal destiny; circumstantiality), and religiosity would predominate.

If mystical experiences were associated with right hemispheric intrusions and religiosity occurs subsequent to maintained left hemispheric activation, then *both* mystical experiences and religiosity would occur in extreme patient populations (Bear & Fedio, 1977) where an insidious degenerative process is occurring. This persistent interhemispheric coherence due to left temporal-lobe foci intercalation (especially if it were secondary to a loss of inhibitory neurons) would facilitate the multiple egodystonic or ego-alien experiences that constitute some Schneiderian symptoms (Ross, 1989); they include thought insertion, thought withdrawal and "hearing" extrapersonal voices; they would be linguistically simple but affective and reflect the syntactic (6 to 7 years old) and semantic sophistication of the normal right hemisphere (Goldberg & Costa, 1981). If (right) prefrontal lobe function is only mildly compromised, one would expect the emergence of idiosyncratic delusions because of the comprise in ability for inferential thinking. Comorbidity of both the prefrontal and temporal lobes would be associated with a formal thought disorder.

Consistent with the model is the hypothesis that any form of schizophrenia is associated with anomalies in the same regions of the left temporal lobe (Deakin, Slater, Simpson, Gilchrist, Skan, Royston, Reynolds, & Cross, 1989; Seidman, 1983) and that a significant portion of this syndrome is the manifestation of continuous subclinical partial epilepsy within the deep temporal lobe structures (Ardila & Gomez, 1988). Intercalation between left and right temporal-limbic cortices would be encouraged because of the former's enhanced metabolic activity and alteration in synaptic organization due to excitotoxic necrosis and reactive synaptogenesis.

During the early stages, when increased very local intersynaptic activity predominates (which would be below the threshold of detection by contemporary positron emission tomography), mild to moderate euphoria and enhanced sensory sensitivity occurs; repeated mystical experiences would be expected. However, once these cells die (as indicated by the generalized left temporal-lobe hypoplasia and enlargement of the left ventricular temporal horn), the incidence of interhemispheric intercalations (and Schneiderian symptoms) would diminish and the linguistic phenomena would be replaced by flat affect and minimal cognition.

The assumption that pleasant/hedonic mood is associated with a normally functioning left hemisphere and anxiety/negative mood is associated with an activated right hemisphere could accommodate the historical contradiction in psychiatry of "anxious-depression." In this instance, periodic increases (perhaps an harmonic of the normal 90-min. to 120-min. periodicity) in right hemispheric metabolic activity relative to a maintained below-normal left hemispheric metabolism would be associated with cycling presentations of anxiety and depression. Their temporal sequencing would not be evident in a single psychiatric interview. Sudden right temporal-limbic lobe intrusions into the below normal metabolic left hemisphere should be particularly frightening (because of the weakness of the self-concept and its affective component—self-esteem) and may explain the strong correlation between depression, panic (or anxiety) attacks, and suicidal impulses.

In the present model a below-normal left hemisphere metabolism should be associated with low self-esteem, poorly integrated self-concept, and depression. Even diffuse decreases in global metabolic activity (a gross inference of attenuated synaptic function), which epidemiologically becomes prominent in the elderly, would be associated with more numerous very local relative decrements in left hemispheric function and should precipitate more frequent and severe periods of depression. From this perspective any process that enhances left hemispheric function, such as social interaction, physical activity or protracted talking, could reduce depression and may explain the nonspecific and generalized successes of the myriad of "talk therapies" (Hock, 1992). Stated alternatively, psychological therapies that emphasize talking "about problems" would be successful because of the artifactual increase in the left (temporofrontal) hemispheric activity that is required for linguistic processing and overt expression. Stimulus-induced prefrontal activity, which accompanies psychotherapies that require both the serial organization of cognition and its verbal expression, would be particularly effective.

However, spontaneous intermittent above-normal right hemispheric metabolism could encourage intense brief intrusions that would ultimately kindle or elevate (in a manner analogous to the 10 to 15 trials of electroconvulsive shock) the left hemispheric function. The phenomenological correlates would include enhanced self-esteem, "restructuring of the self-concept" and sudden understanding. Emergence of "the new self" following religious conversions is not unusual and often accompanies a peak or oceanic experience that is subsequent to significant psychological depression. The hedonistic surge should reinforce the self-concept while the normalized left hemispheric activity should maintain it.

The differential activation of the left and right hemispheric processes could also explain the immunological changes that contribute to altered health following some mystical and religious experiences. Maintained eleva-

tion of the vigilance-mediating right hemisphere should be associated with elevated ACTH, systemic immunosuppression and the development of disorders of cellular immunity (Biziere, Guillaumin, Degenne, Bardos, Renoux, & Renoux, 1985). Promotion of some classes of cancer would be expected.

On the other hand, differential activation of the left hemisphere would encourage immunofacilitation and activation of the (thymus) lymphocytic cell pathway. This could explain our observation of a possible association between indices of early mild right hemispheric damage and the development of autoimmune-related disorders such as multiple sclerosis and juvenile diabetes. However, such immunofacilitation could also accommodate the health improvements that are reported to follow some religious conversions and that accompany positive changes in self-concept, self-esteem, and other correlates of enhanced left hemispheric metabolism. According to this model enhanced right hemispheric metabolism (generalized anxiety) and below-average left hemispheric metabolism (depression) would be associated with the greatest immunosuppression and could explain the strong concordance between severe depression and cancer (Rossi, 1986).

Cumulative effects of transient interhemispheric intrusions would be qualitatively less evident but quantitatively more detectable. If any neural organization that promotes frequent right hemispheric intrusions is associated with a sensed presence, negative affect, and lower self-esteem (Persinger & Makarec, 1991a), then normal women (because they show less functional lateralization and greater interparietal lobe electrical coherence; Corsi-Carrera, Herrera, & Malvido, 1989; Gordon & Kravitz, 1991) and left-handed men (Harshman & Hampson, 1988) and men with language-learning disorders should experience (compared to normal right-handed men) lower self-esteem, more frequent mystical (paranormal) experiences, and sensed fearful presences that are independent of religious beliefs. These populations should be more vulnerable to religious conversions or political shifts that promote sudden increases in self-esteem.

The concomitant fear of more frequent (compared to men) right hemispheric intrusions should elevate the incidence of phobias among women (Persinger & Makarec, 1991b). Elevated sensed presences, phenomenological correlates of intrusions from the right parietotemporal regions, are more frequent in left-handed men [whose brains could be considered more similar to normal right-handed women] who have learned to meditate (Persinger, 1992a). In light of the sexual dimorphism of the brain (Rémillard, Andermann, Tests, Gloor, Aube, Martin, Fendel, Guberman, & Simpson, 1983), there should also be a significant subpopulation of women who display elevated right mesiobasal/temporal lobe activity and who experience nocturnal sexual phenomenology such as the felt lover, incubus, or alien entity. Because normal women may display larger areas within the midline thalamic

nuclei (Aguirre & Simmons, 1988), a major input for the central amygdaloid nucleus, bilateral activation of the cortices would facilitate conditions that lead to right hemispheric intrusions and fearful phenomenology.

The greater relative representation of language processes (the correlate of the sense of self) in the right hemisphere of normal women should promote multiple but weaker neural processes with which the self-concept is associated. These predictions, including the estimated 9:1 female:male ratio in multiple personality disorders (Putnam, 1988) have been supported (Ross, 1989). Because amygdaloid-hypothalamic anomalies in temporal lobe epilepsy promote feminization within the male brain, as defined by hypogonadism and hyperprolactinemia (Spark, Willis, & Royal, 1984), the men who have histories of temporal lobe epilepsy (particularly adolescent onset) should also experience similar phenomenology. However, any process that allows greater representation of linguistic processes in the right hemisphere, such as an early brain injury, would encourage these experiences.

A strictly materialistic interpretation of the vectorial hemisphericity model is that mystical and religious experiences are autogenic phenomena. However, there is accumulating evidence that the right hemisphere (because its organization is diffuse) of the normal human brain may be responsive to subtle external environmental stimuli that are relevant to the survival of the species (Persinger, 1983b). The patterns of these stimuli would evoke neural activity in the right hemisphere that could affect or even determine the content of the intrusion. Brains (such as in normal, right-handed women) that contain more linguistic processing capacity within right hemispheric operations would display greater capability to translate (accurately) these stimuli into "paralinguistic" patterns of which the person could be aware.

Detailed examination of the themes and content of these verbal sequences could reveal the intrinsic differences between the processes by which the left and right hemispheres code experience. For example, in routine multiple personality disorders, "subpersonalities" are frequently younger and display limited syntactic sophistication (Cummings, 1985). However, more sophisticated variants of the multiple personality syndrome, such as the trance medium (e.g., Jane Roberts), display complex semantic patterns that are characterized by visuospatial and holistic metaphors. Interestingly, the majority of these individuals have had histories, such as (temporal lobe) complex partial epilepsy or an early brain injury that would be conducive to hemispheric intrusions (Assailly, 1963).

The isolation and understanding of the neuroelectrical bases of mystical experiences and religious conversions are important in light of their powerful modifications of the sense of self and the subsequent change in beliefs and behavior. If their bases were understood and hence could be generated experimentally, application to clinical intervention for the treatment of depression,

anxiety, and dissociation could become a powerful tool. The model of vectorial hemisphericity could be a useful metaphor for designing experiments that could isolate the neurocognitive bases of these experiences.

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